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ECONOMIC RESEARCH AID

RUBLE-DOLLAR RATIO FOR SOVIET AIRCRAFT

CIA/RR A.ERA 60-9
August 1960

CENTRAL INTELLIGENCE AGENCY

OFFICE OF RESEARCH AND REPORTS

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FOREWORD

Sufficient data are not available to permit the direct valuation of Soviet aircraft in rubles. Costs of Soviet aircraft are based on estimates of the cost to the US aircraft industry to produce the Soviet aircraft as they are built in the USSR. The dollar valuation of Soviet aircraft can be converted to rubles if the available data on the cost of Soviet aircraft are adequate for ascertaining a ruble-dollar ratio that is reasonably firm. The purpose of this research aid is to establish such a ruble-dollar ratio.

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CONTENTS

		Page
	Summary	1
I.	Introduction	1
	[redacted]	
III.	Learning Curve	2
IV.	Ruble-Dollar Ratio for the Cab Aircraft	2
V.	Ruble-Dollar Ratio for the Fagot Aircraft	4
VI.	Ruble-Dollar Ratio for the VK-1 Aircraft Engine	8
VII.	Ruble-Dollar Ratio for the VK-1A Aircraft Engine	8
VIII.	Conclusions	9

25X1

Appendix

Production of Cab (Li-2) Aircraft at Tashkent Airframe Plant No. 84 11

Tables

1. Contract Prices of the US C-47 Aircraft, 1942-45 . . . 5

2. Cumulative Average Price of the Soviet Fagot (MIG-15) Airframe If Produced by a US Manufacturer 6

3. Estimates of Cumulative Production of Fagot (MIG-15) Aircraft in Soviet Airframe Plants, 1948-49 6

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Approved For Release 2003/11/05 : CIA-RDP79S01046A000800030001-0

Approved For Release 2003/11/05 : CIA-RDP79S01046A000800030001-0

Charts

		Following Page
Figure 1.	Average Price Curve for the US C-47 Aircraft	4
Figure 2.	Production of the Soviet Cab (Li-2) Aircraft at Tashkent Airframe Plant No. 84, 1945-51	4
Figure 3.	Cumulative Average Price Curve for the Soviet Fagot (MIG-15) Airframe If Produced by a US Manufacturer	4

Approved For Release 2003/11/05 : CIA-RDP79S01046A000800030001-0

Approved For Release 2003/11/05 : CIA-RDP79S01046A000800030001-0

RUBLE-DOLLAR RATIO FOR SOVIET AIRCRAFT*

Summary

The ruble-dollar ratio for Soviet aircraft from 1950 through 1954, based on prices of US counterparts, is about 5.5 to 1. This ratio may be used in approximating the price of both Soviet aircraft and aircraft engines. The ratio, however, is not intended to establish a precise relationship, because the cumulative number of aircraft for which Soviet prices are quoted is unknown.

I. Introduction

This research aid compares quoted prices for the Soviet Cab (Li-2) aircraft and for the Fagot (MIG-15) aircraft, without its engines, with the prices that US manufacturers would charge for these aircraft. The Soviet prices for the VK-1A aircraft engine are compared with the prices charged for its US counterpart. A ruble-dollar ratio is thus obtained for Soviet aircraft prices.

The analysis follows the steps given below.

1. Similar aircraft and aircraft engines are compared.

2. The effect on prices of different quantities produced is considered, and adjustments are made empirically, based on historical learning curves.

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* The estimates and conclusions in this research aid represent the best judgment of this Office as of 15 July 1960.

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III. Learning Curve

When the price of an aircraft produced at one plant is compared with the price of a similar aircraft manufactured at a different plant, the comparison must be made at the same number of units produced, for the price decreases in relation to the number of units.

By the use of the learning curve, the successive decreases in production effort per unit are related to the number of units produced. The learning curve is a geometric progression that expresses the decreasing cost required to accomplish any repetitive operation as the operation is continued. The cost may be in terms of dollars or in terms of man-hours. The learning curve forecasts that the cost required to produce an article will decrease each time that article is produced and that the amount of decrease will be less with each successive unit. The slope of the curve is expressed as a percentage, which is the expression of the ratio between the cost per unit at any number of units and the cost at twice that number of units. For example, on an 80-percent learning curve, if the cost of the first unit is US $100,000, the cost of the second unit is US $80,000 and the cost of the fourth unit is US $64,000. Thus the learning process continues.

IV. Ruble-Dollar Ratio for the Cab Aircraft

The Cab aircraft is the Soviet model of the US C-47 aircraft. Therefore, the prices of the C-47 were used for comparison with the prices of the Cab. Soviet airframe plants are roughly comparable to US airframe branch plants because many functions performed by the parent plant in the US are normally performed in Moscow for the entire Soviet serial-production airframe industry. Consequently, the prices of the C-47 aircraft used for comparison are those prices for the C-47 aircraft built at a branch plant of a US aircraft company.

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Approved For Release 2003/11/05 : CIA-RDP79S01046A000800030001-0

Approved For Release 2003/11/05 : CIA-RDP79S01046A000800030001-0

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Inasmuch as there is no price index for US aircraft to adjust for changes in dollar purchasing power, the wholesale price index for metals and metal products as given each year in the economic report of the President to the Congress was used as a price index for US aircraft. On the basis of price data furnished by a US aircraft manufacturer, there seems to be a correlation between fluctuations in the price index for metals and metal products and fluctuations in aircraft prices. The lack of a price index for US aircraft is, however, one of the major weaknesses in the attempt to establish a ruble-dollar ratio for aircraft.

The prices of the C-47 aircraft in 1945 US dollars were plotted in Figure 1** against cumulative aircraft production, and an average price curve was fitted to these prices by use of the method of least squares. After the price curve of the C-47 aircraft had been worked out, the next step was to decide what cumulative aircraft numbers were to be used in determining the ruble-dollar ratio of the prices

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of the Cab aircraft quoted by Tashkent Airframe Plant No. 84.

The cumulative production of Cab aircraft at Tashkent Airframe Plant No. 84 was estimated to be 2,540 aircraft as of 1 January 1947 and 2,610 aircraft as of 1 July 1947. The average unit price of the 70 C-47 aircraft from unit 2,540 through unit 2,610 was computed to be US $84,000. This price was converted to 1947 US dollars as follows:

$$\text{US } \$84{,}000 \times \frac{\text{Price Index for 1947}}{\text{Price Index for 1945}} = \text{US } \$84{,}000 \times \frac{91.3}{65.9} = \text{US } \$116{,}000$$

* Table 1 follows on p. 5.
** Following p. 4.

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The cumulative production of Cab aircraft at Tashkent Airframe Plant No. 84 was estimated to be 3,270 aircraft as of 1 July 1949 and 3,440 aircraft as of 1 January 1950. The average unit price of the 170 Cab aircraft from unit 3,270 through unit 3,440 was computed to be US $81,000. [redacted] 25X1

25X1 [redacted] The price of the C-47 then was converted to 1950 US dollars as follows:

$$\text{US } \$81{,}000 \times \frac{\text{Price Index for 1950}}{\text{Price Index for 1945}} = \text{US } \$81{,}000 \times \frac{110.3}{65.9} = \text{US } \$136{,}000$$

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[redacted]

V. Ruble-Dollar Ratio for the Fagot Aircraft

Unlike the Cab aircraft, no US counterpart exists for the Soviet Fagot aircraft. A US aircraft manufacturer has estimated that if the Fagot aircraft had been produced in his plant, the cumulative average price at the 1,000th Fagot airframe would have been 1954 US $102,000. The slope of the cumulative average price curve for airframe unit 100 through 2,000 would be about 87 percent. The cumulative average price for the indicated airframe number is given in Table 2,* and the cumulative average price curve is shown in Figure 3.**

* Table 2 follows on p. 6.
** Following p. 4. (Text continued on p. 6.)

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Figure 1

AVERAGE PRICE CURVE FOR THE US C-47 AIRCRAFT

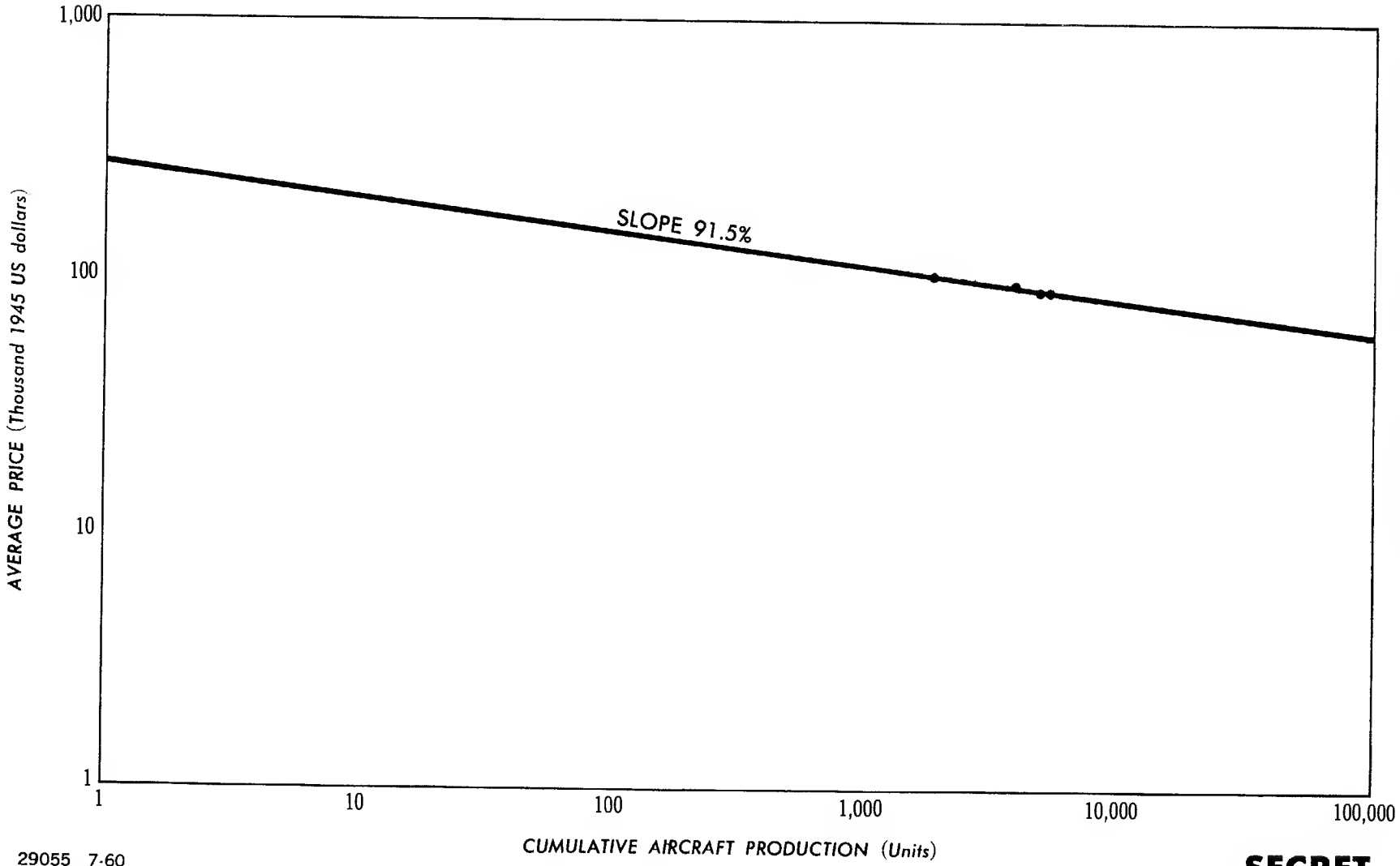

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Figure 2

PRODUCTION OF THE SOVIET CAB(LI-2) AIRCRAFT AT TASHKENT AIRFRAME PLANT No. 84 1945-51

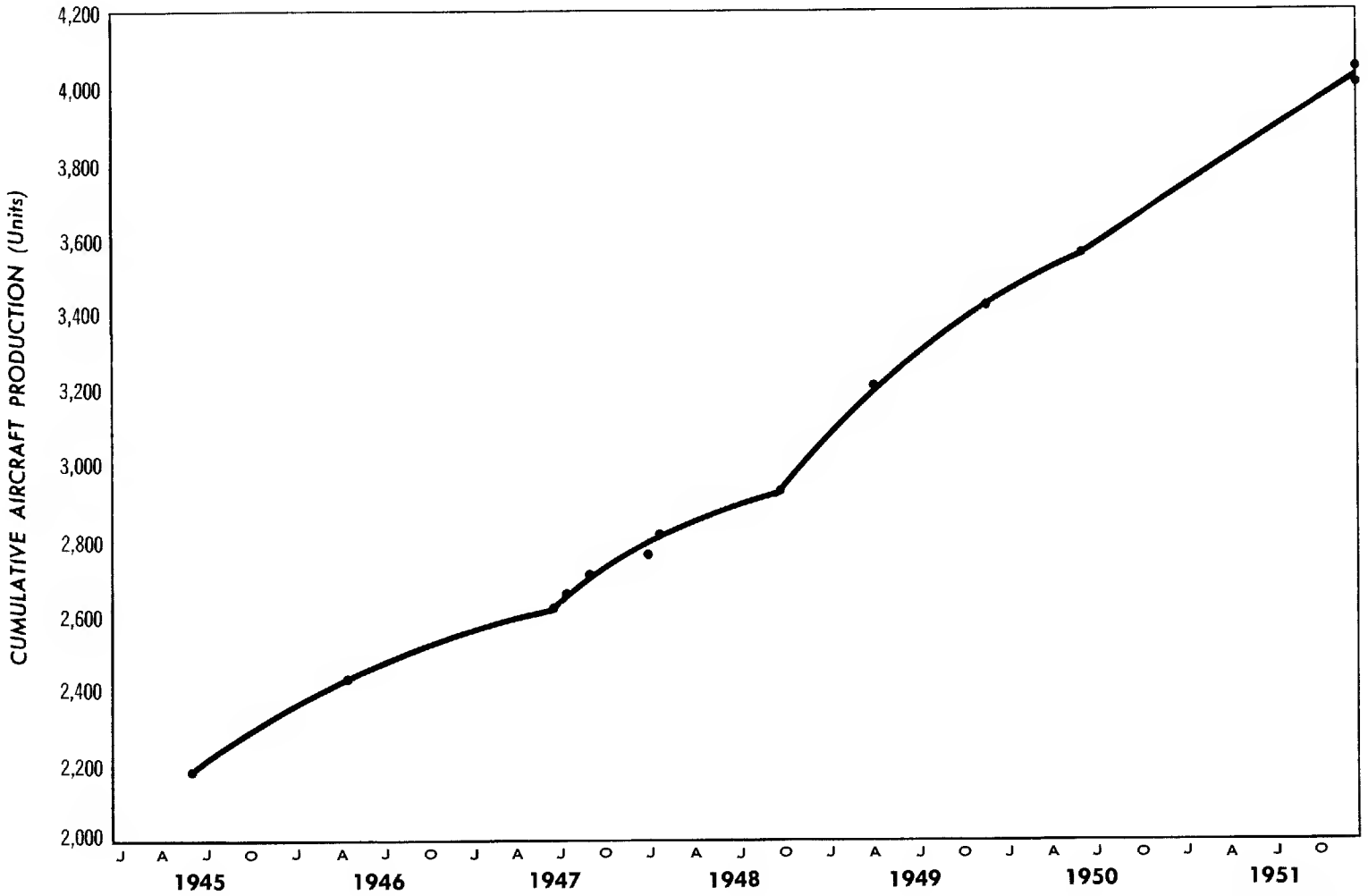

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Figure 3

CUMULATIVE AVERAGE PRICE CURVE FOR THE SOVIET FAGOT (MIG-15) AIRFRAME IF PRODUCED BY A US MANUFACTURER

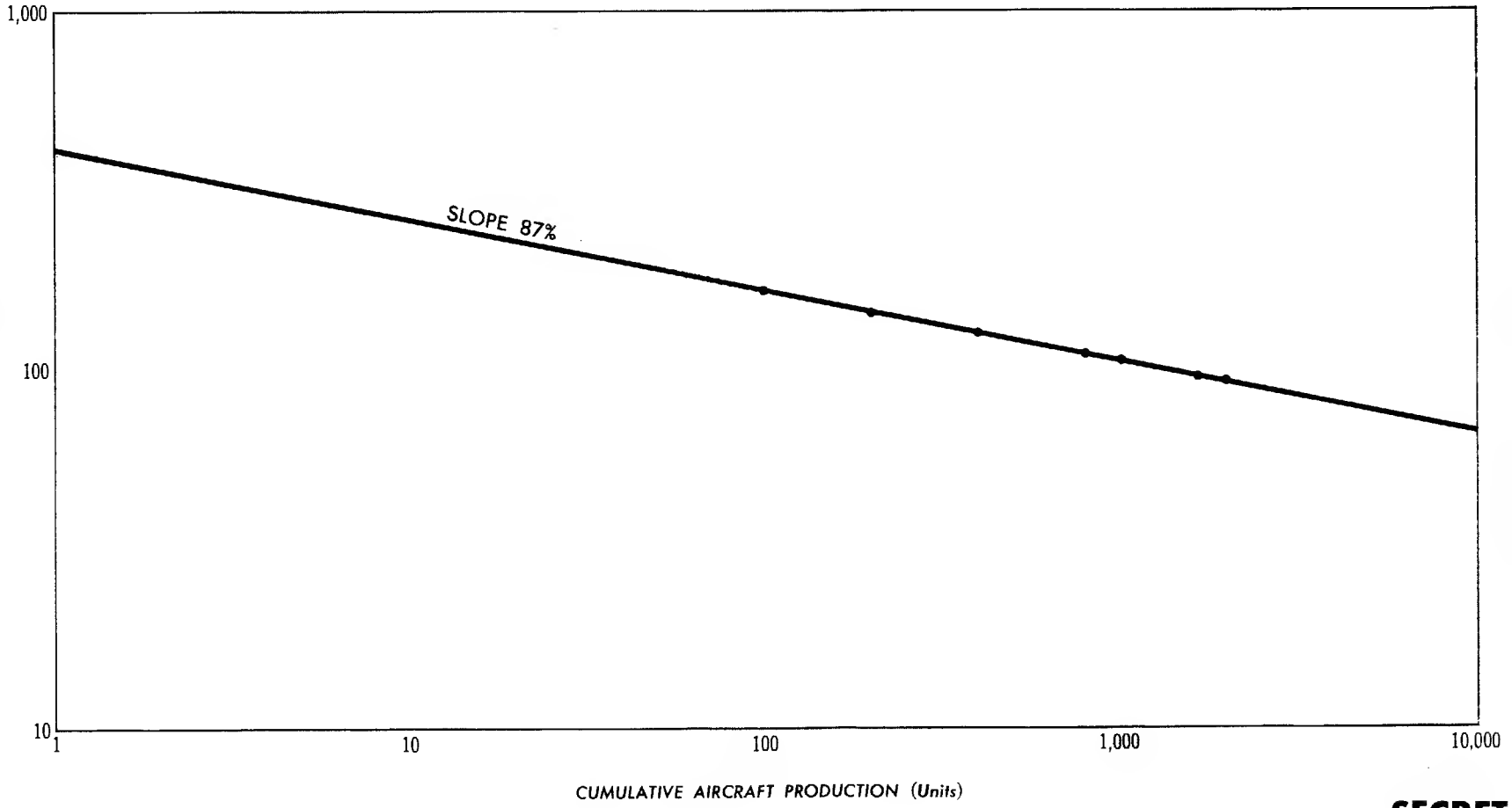

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Table 1

Contract Prices of the US C-47 Aircraft
1942-45

(1) Contract Number	(2) Year	(3) Quantity (Units)	(4) Unit Price of C-47 Airframes (Current US $)	(5) Price of Government-Furnished Equipment on C-47 Aircraft a/ (Current US $)	(6) Unit Price of C-47 Aircraft b/ (Current US $)	(7) Price Index of Metal Products (1947-49 = 100)	(8) Unit Price of C-47 Aircraft c/ (1945 US $)	(9) Cumulative Average Price of C-47 Aircraft d/ (1945 US $)
AC-28405	1942	1,800	71,631	27,911	99,542	64.9	101,000	101,000
AC-40652	1943	2,000	52,771	28,508	81,279	64.8	82,700	91,400
AC-2032	1944	966	49,441	30,692	80,133	64.8	81,500	89,400
AC-2929	1945	264	43,122	27,674	70,796	65.9	70,796	88,400

a. Prices of government-furnished equipment less 80 percent of the price of electronic equipment.
b. Column 4 plus Column 5.
c. Unit price of C-47 aircraft in current US dollars converted to 1945 US dollars by use of the index in Column 7.
d. Unit price of C-47 aircraft in 1945 US dollars multiplied by quantities produced in each year divided by cumulative production up to and during the respective year.

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Table 2

Cumulative Average Price
of the Soviet Fagot (MIG-15) Airframe
If Produced by a US Manufacturer

Airframe Number	Price (1954 US $)
100	166,000
200	140,000
400	124,000
800	107,000
1,000	102,000
1,600	94,700
2,000	90,800

The prices furnished by the US manufacturer did not include government-furnished aircraft equipment. ATIC estimated the price of government-furnished aircraft equipment on the Fagot to be US $38,800 in 1953 prices.

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Table 3

Estimates of Cumulative Production
of Fagot (MIG-15) Aircraft in Soviet Airframe Plants
1948-49

Plant Number	Location	Cumulative Production (Units)
1	Kuybyshev	770
21	Gor'kiy	20
153	Novosibirsk	120
292	Saratov	90
126	Komsomol'sk	0

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US $187,000 x 0.80 = US 1954 $150,000

This price then was converted to 1950 prices, giving

$$\text{US } \$150{,}000 \times \frac{\text{Price Index for 1950}}{\text{Price Index for 1954}} = \text{US } \$150{,}000 \times \frac{110.3}{128.0} = \text{US } \$129{,}000$$

Next, the price of equipment had to be added to the price of the airframe. The price of equipment in 1950 prices was found to be

$$\text{US } \$38{,}800 \times \frac{\text{Price Index for 1950}}{\text{Price Index for 1953}} = \text{US } \$38{,}800 \times \frac{110.3}{126.9} = \text{US } \$33{,}700$$

Thus the price of the Fagot aircraft without engines would be US $163,000 in 1950 prices, [redacted] 25X1

25X1 [redacted]

If, however, the assumption is made that the price charged the military was based on the average price of the Fagot aircraft produced in the USSR through 1949, a ruble-dollar ratio of 6.3 to 1 is obtained. If the price charged for the Fagot is assumed to be based on the average price of the first 40 aircraft, a ruble-dollar ratio of 4.3 to 1 is obtained.

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VI. Ruble-Dollar Ratio for the VK-1 Aircraft Engine

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[redacted] The J 48-P-6 aircraft engine was chosen as the closest US equivalent of the Soviet VK-1 aircraft engine. Both the Soviet and the US engines were developed from the British Rolls Royce Nene turbojet engine. The two engines are comparable in both weight and maximum thrust, as follows:

$$\text{VK-1:} \quad \frac{1{,}930 \text{ pounds weight}}{5{,}950 \text{ pounds thrust}} = 0.324 \frac{\text{pound}}{\text{pound thrust}}$$

$$\text{J 48-P-6:} \quad \frac{2{,}000 \text{ pounds weight}}{6{,}250 \text{ pounds thrust}} = 0.320 \frac{\text{pound}}{\text{pound thrust}}$$

The prices of US aircraft engines do not follow a learning curve: prices are the same for the first engine as for later engines.

The price of the J 48-P-6 aircraft engine as of March 1955 was US $55,600. The price of the engine in 1950 prices was found to be

$$\text{US } \$55{,}600 \times \frac{\text{Price Index for 1950}}{\text{Price Index for 1955}} = \text{US } \$55{,}600 \times \frac{110.3}{136.6} = \text{US } \$44{,}900$$

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VII. Ruble-Dollar Ratio for the VK-1A Aircraft Engine

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[redacted] The J 48-P-8 is the closest US equivalent of the Soviet VK-1A. The two engines are compared in both weight and maximum thrust, as follows:

$$\text{VK-1A:} \quad \frac{2{,}010 \text{ pounds weight}}{7{,}000 \text{ pounds thrust}} = 0.287 \frac{\text{pound}}{\text{pound thrust}}$$

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J 48-P-8: $\frac{2{,}050 \text{ pounds weight}}{7{,}250 \text{ pounds thrust}} = 0.283 \frac{\text{pound}}{\text{pound thrust}}$

The price of the J 48-P-8 was US $58,700 in 1954 prices.

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VIII. Conclusions

The ruble-dollar ratio for Soviet aircraft appears to range from a low of about 4.3 to 1 to a high of 6.3 to 1. The ruble-dollar ratio for Soviet aircraft engines is approximately 5.5 to 1. The ratio of 5.5 to 1 is recommended for the pricing of Soviet military aircraft and aircraft engines produced from 1950 through 1954.

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